Space Weather Technical Forecast

Issued on Sunday, 13 February 2022 at 00:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Minor R1 Radio Blackouts. Rising Chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate with an M1.4 flare observed from the vicinity of a new sunspot region at 12/0844UTC near the southwestern limb. This event was linked with both Type II and IV radio bursts, with an estimated speed of ejecta at 642km/s. X-ray flares were otherwise mostly modest in size, with a few C-class events well-spread between the groups occupying the western limb.
There are currently four sunspot regions on the facing side of the sun. A mature Fai/Beta in the form of AR2941, with slight growth in its intermediate spots the main trend observed. In the southeastern quadrant, a pair of bi-polar regions AR2946 and secondly a newly-developing region. The final sunspot on the disc was AR2946 in the eastern solar hemisphere, with the leading sunspot becoming the dominant feature and classified currently as Cai/Beta.
The past 24 hours have seen numerous apparently minor Coronal Mass Ejections (CMEs) on coronagraph imagery. None of these appear to have an Earth-directed component, emanating mostly in the rear-facing western quadrant. In particular, there is an absence of any westward-directed ejecta on STEREO A COR2 imagery (i.e. potentially in the Earth sector). The M1.4 CME from the southwestern limb and the associated Type-II will probably miss Earth. At present then, no confirmed Earth-directed Coronal Mass Ejections (CMEs) were in evidence, but confidence is lower than average.

Solar Wind / Geomagnetic Activity: Solar winds, as measured DSCOVR at L1 are elevated with a peak of 600 km/s observed at 12/0459 UTC and the source of this apparent fast wind is uncertain, but probably related to CH53/-, with the phi angle accordingly negative (towards the sun). Density was mostly near average and the IMF was weak and peaked around 8nT, with a range in north-south component (Bz) from +8nT to -16nT. The net result of the above solar wind measures was Quiet to Unsettled geomagnetic activity (Kp 2-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at Background levels. The high energy electron flux (greater than 2MeV) was at Background to Moderate levels during the past 24 hours. The corresponding 24-hour integrated electron fluence values started just below the active threshold level before declining later in the period with reading of 1.17e7 integrated pfu observed at 13/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain mostly Low through the next four days, but with a daily Slight Chance (20%) of M-class flares. Sunspot regions are expected to be in a state of flux in the period, with numerous departures and arrivals, and confidence is therefore rather low.

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Met Office Space Weather Technical Forecast

Solar Wind / Geomagnetic Activity: No CMEs feature in this forecast period, although confidence in this is somewhat lower than usual owing to imagery gaps. The current high speed stream is thought most likely to be the expected CH53, and elevated solar winds are likely for much of the period and this will result in generally Quiet to Unsettled geomagnetic activity, with the greatest chance of Active intervals on days 1 and 2 (13 and 14 Feb).

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at Background levels, but with a daily Slight Chance of S1. The high energy electron forecast should initially maintain current levels, before showing a rising trend into the new working week following the high speed stream from CH53.

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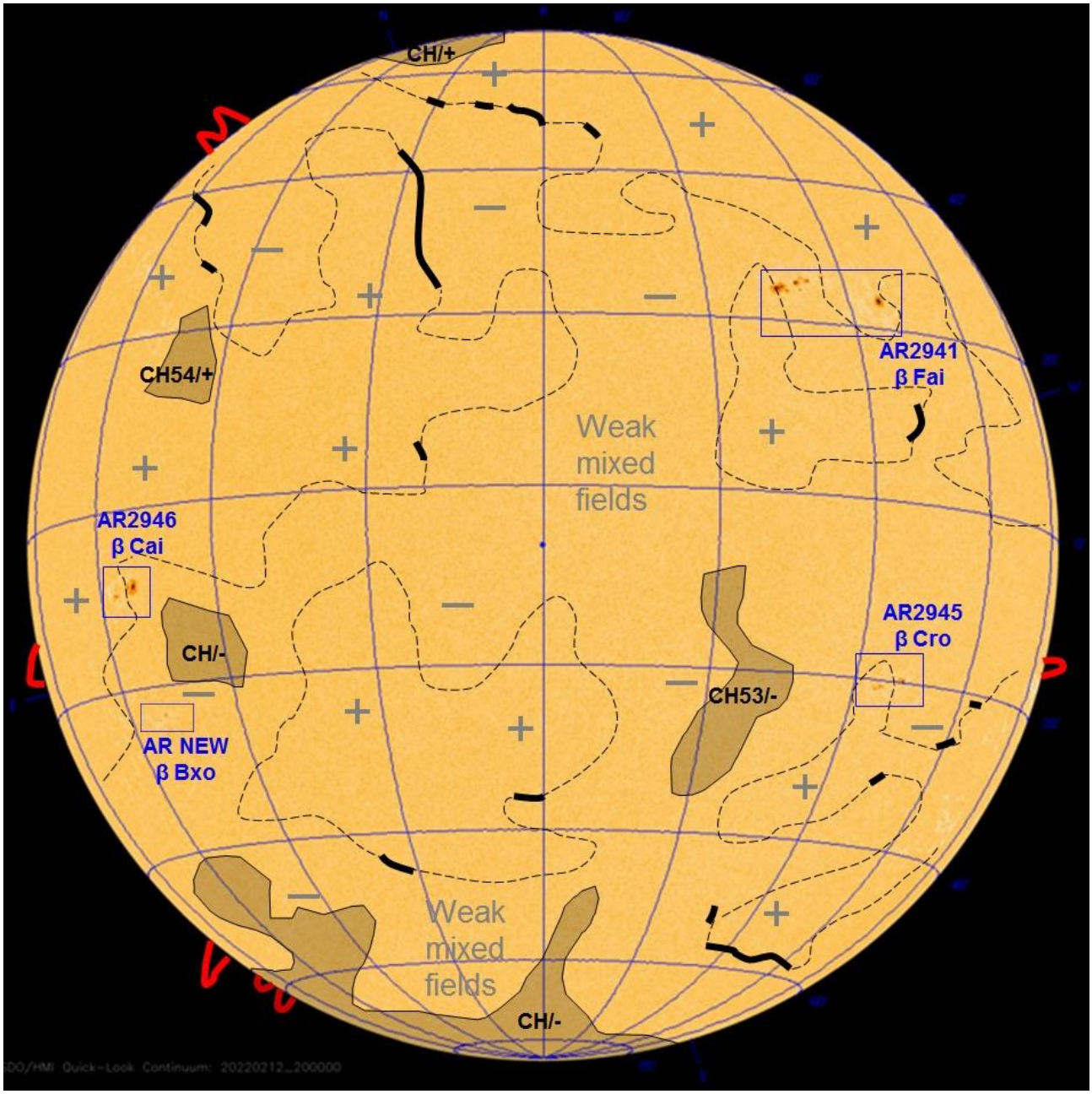
Figure 1. Solar Analysis Valid 2000 UTC, 12 February 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

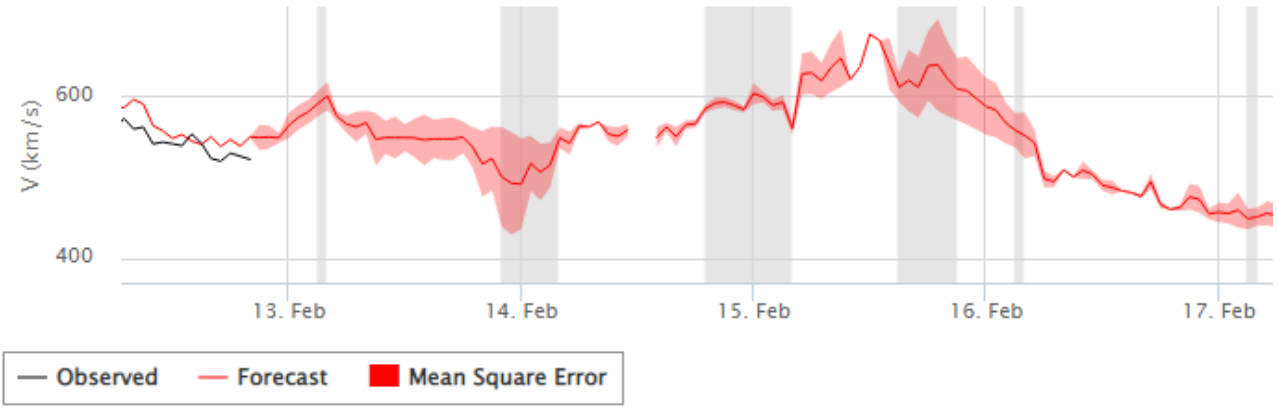
No CMEs feature in this forecast at present, however confidence in this is somewhat lower than usual given numerous (particularly westward) CMEs with imagery gaps hampering analysis. The M1.4 CME is not considered to be Earth-directed. Earth is now under the influence of a high speed stream (HSS) and the cause of this is thought most likely to be CH53, which is similar to persistence. Geomagnetic activity has probably peaked and with no further fast wind features, although there is the caveat that recent minor transients may pollute the forecast, lowering confidence. The forecast is for Quiet to Unsettled activity and the greatest chance of Active intervals is likely to be on days 1 and 2 (13 and 14 Feb).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Winds Prediction Model, indicating elevated solar winds for the next few days.



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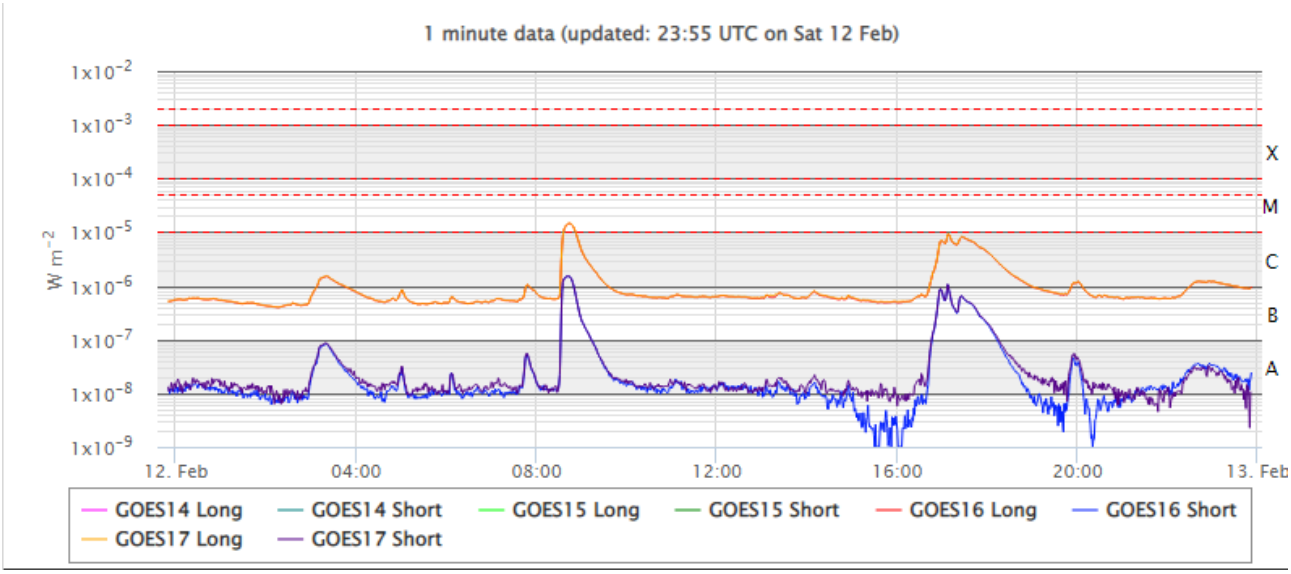
Radio Blackouts - X-Ray Flares:
The balance of sunspot groups should enter a state of flux over the forecast period. Returning regions Ex-2935 and Ex-2934 should begin to rotate onto the visible disc into the new working week, with both appearing on far-side soundings and EUV imagery. This is in contrast to the depopulation expected to occur of the current western limb. This is all happening in the context of a changing disc, with an as yet unnumbered region likely to have produced the most significant event of the period, despite its apparent lowly Bxi/Beta classification.
The X-ray forecast on balance starts with a daily Chance of M-class flares, reducing to a Slight Chance by days 3 and 4 (15 and 16 Feb), however this may be revised further downwards should the eastern horizon spots fall short of expectations as the western limb quietens down.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	15	10
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3:X-ray flux plot at GEO over the past 24 hours with M-class flare in morning.



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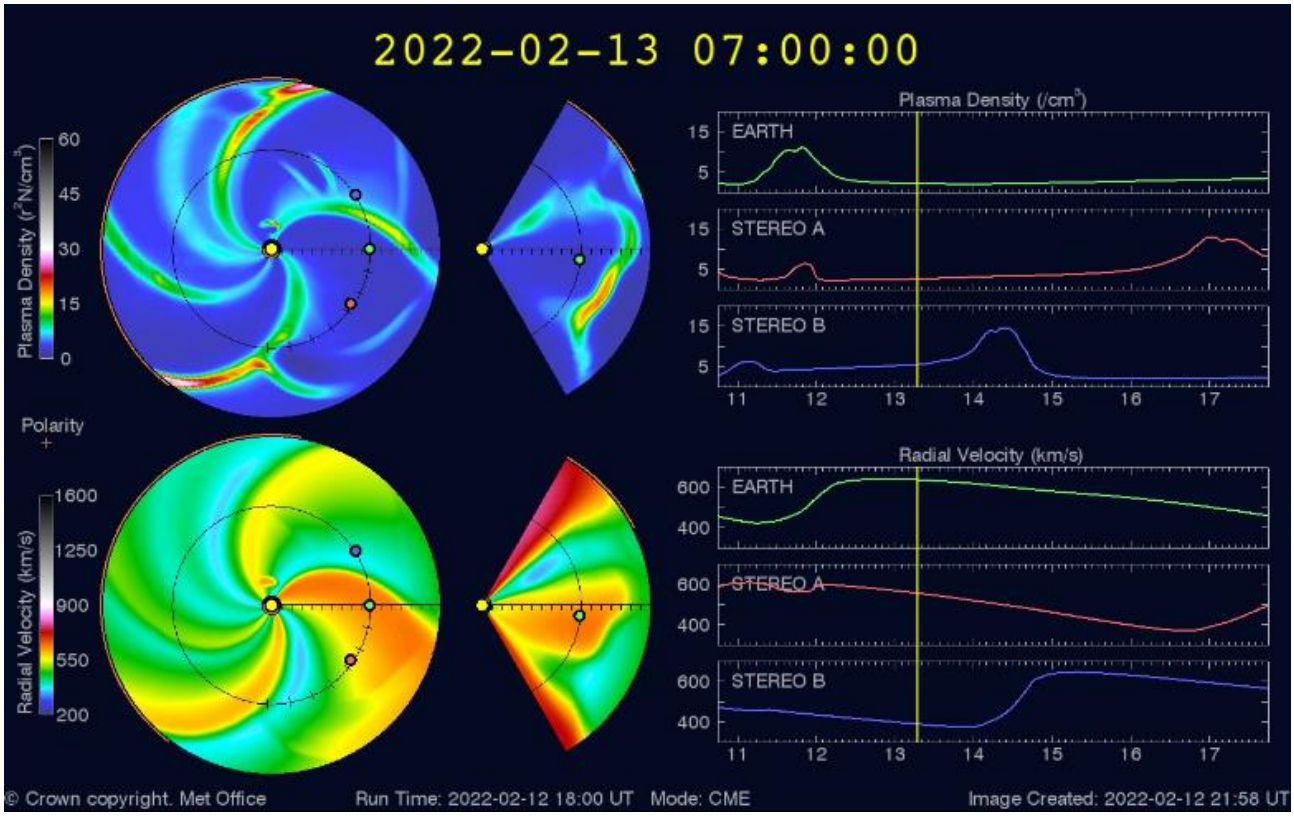
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux, as measured by GOES-16 is at background levels. Solar radiation storms are not expected in the period. However, there is a very slight chance for proton fluxes to rise given any significant flaring from regions close to the western limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office ENLIL output with a good representation of the current HSS affecting Earth.



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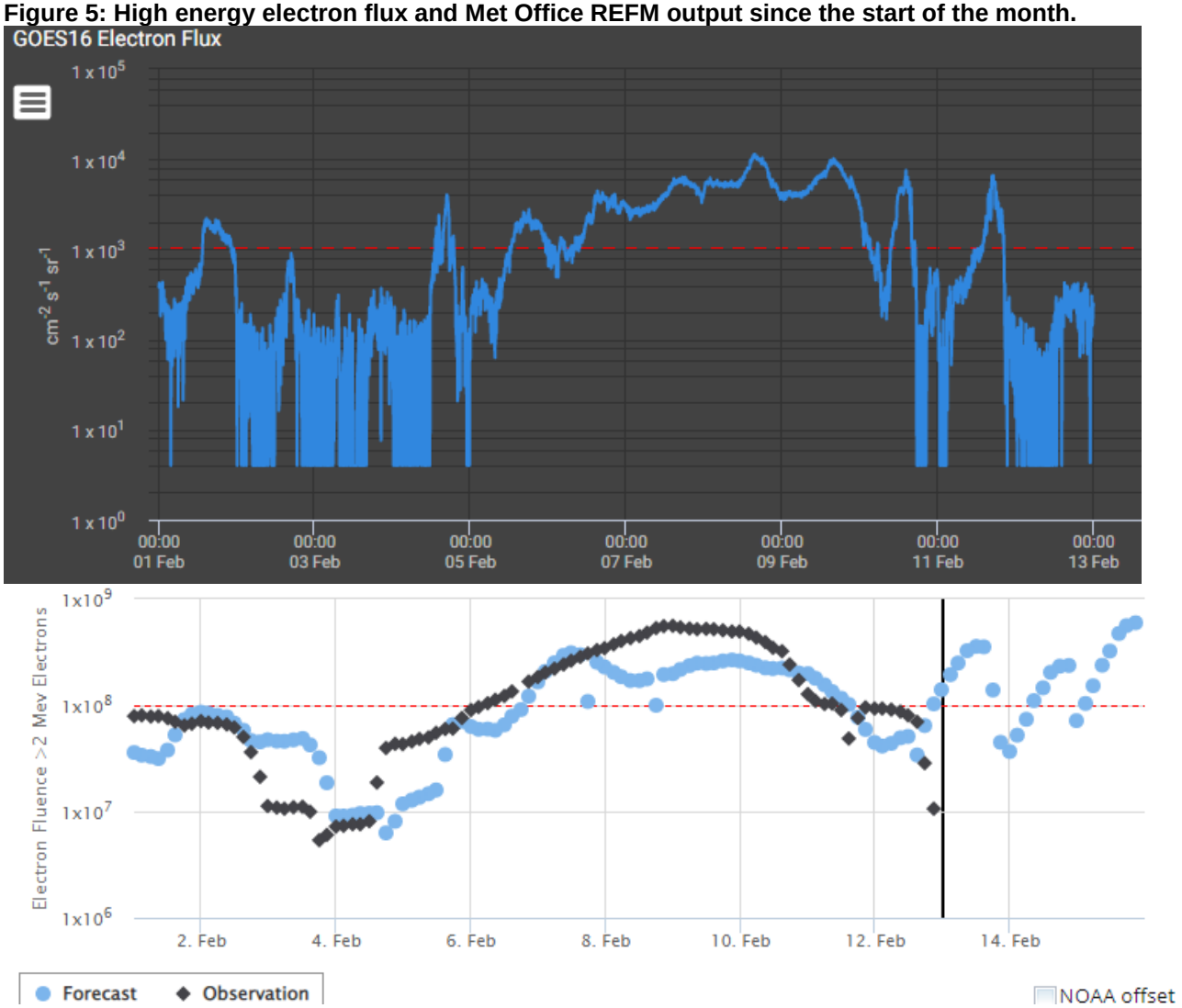
High Energy Electrons Event (≥ 2MeV):
Confidence in the electron forecast is now rising, with the current coronal hole fast wind so far proving similar on this pass to last rotation, now assumed to be CH53. This feature's predecessor saw eventual marginal exceedence of the Active 24-hour integrated fluence threshold. This gives a rising probability of exceedence of Active from current levels in the four-day period, with the caveat of minor transient activity perhaps polluting the forecast later in the four days.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	60	70	70	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy electron flux and Met Office REFM output since the start of the month.



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